

Final Technical Report

September 26, 1995

Grant ONR N00014-93-1-1271

"Airborne Doppler Radar Investigation of Atmospheric Convection in TOGA COARE"

R. A. Houze, Jr., Principal Investigator

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SUMMARY OF COMPLETED PROJECT:

This one-year grant provided the funding for the third year of a three-year proposal. In the first two years, funded by NSF, the researchers helped design the aircraft measurement program of TOGA COARE and used aircraft in the field to obtain a data set on the entire spectrum of clouds and weather regimes over the warm pool. The third year funding was used to analyze the whole spectrum of convection over the warm pool, using the data obtained, along with satellite data, ship and buoy observations, large-scale wind fields, and sounding data.

During the TOGA COARE Project, 200 hours of airborne Doppler radar data were collected and aircraft missions sampled not only deep convection but the whole spectrum of convection. This was the first time that airborne multiple Doppler radars have been applied extensively in near equatorial convection. An atlas of TOGA COARE aircraft mission summaries was produced, with over 1000 maps of aircraft tracks, satellite data, and radar data. (Yuter et al. 1995, BAMS) Another atlas was produced of satellite data analyses used in the field in COARE. (Chen et al. 1995, BAMS) Both atlases were published electronically via Mosaic. These compilations of aircraft data provide valuable new resources for studying tropical convection, and understanding this convection is crucial to understanding the global circulation and short term climate variability such as associated with El Niño.

Included in the airborne Doppler data were over 140 vertical profiles of divergence obtained by a new method called "purls". The "purls" were analyzed to determine how the environment responds to the heating and cooling processes occurring in cloud clusters formed during the time period of the COARE field experiment. (Mapes and Houze, 1995, JAS) The Mapes and Houze study in particular showed how the subdivision of tropical cloud clusters into convective and stratiform components relates to the interaction with the large-scale flow. Since the stratiform region is characterized by cooling and subsidence, and since the effects of the stratiform region linger after the convective region heating effects propagate away, the lower troposphere responds to the cluster by compensating upward motions, not downward motions. This dispersion encourages new convection in the vicinity of old convection. These insights into the basic mechanisms of convective interaction with the large-scale environment help us to understand how heating and cooling processes affect the large-scale circulation in the tropics, a longstanding problem in global meteorology.

(continued)

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PUBLICATIONS:

Yuter, S. E., R. A. Houze, Jr., B. F. Smull, F. D. Marks, Jr., J. R. Daugherty, and S. R. Brodzik, 1995: "TOGA COARE aircraft mission summary images: An electronic atlas." *Bulletin of the American Meteorological Society*, **76**, 319-328.

Chen, S. S., R. A. Houze, Jr., B. E. Mapes, S. R. Brodzik, and S. E. Yuter, 1995: "TOGA COARE satellite data summaries available on the World Wide Web." *Bulletin of the American Meteorological Society*, **76**, 329-333.

Mapes, B. E., and R. A. Houze, Jr., 1995: "Diabatic divergence profiles in western Pacific mesoscale convective systems." *Journal of the Atmospheric Sciences*, **52**, 1807-1828.

Chen, S. S., R. A. Houze, Jr., and B. E. Mapes, 1994: "Satellite-observed cloud clusters during TOGA COARE." *Preprints, Ninth Conference on the Middle Atmosphere and Seventh Conference on Satellite Meteorology and Oceanography*, Monterey, June 6-10, American Meteorological Society, 22-25.



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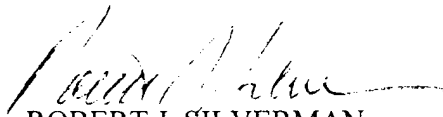
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From: Director, Office of Naval Research, Seattle Regional Office, 1107 NE 45th St., Suite 350,
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Subj: RETURNED GRANTEE/CONTRACTOR TECHNICAL REPORTS

1. This confirms our conversations of 27 Feb 97 and 11 Jul 97. Enclosed are a number of technical reports which were returned to our agency for lack of clear distribution availability statement. This confirms that all reports are unclassified and are "APPROVED FOR PUBLIC RELEASE" with no restrictions.

2. Please contact me if you require additional information. My e-mail is silverr@onr.navy.mil and my phone is (206) 625-3196.


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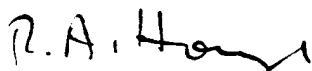
Sept. 26, 1995

Dr. Robert F. Abbey, Jr.
Code 322MM, ONR
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Dear Dr. Abbey:

Herewith find the Final Technical Report for the ONR Grant N00014-93-1-1271,
"Airborne Doppler Radar Investigation of Atmospheric Convection in TOGA COARE."

Yours truly,



Robert A. Houze, Jr.
Professor

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